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PATENT
Payton

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of

Goldberg (TI-25588)

Serial No. 09/085,298

Filed: May 27, 1998

Group Art Unit: 2822

Examiner: K. Duang

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TECHNOLOGY CENTER 2800

For: Method for Thermal Nitridation and/or Oxidation of Semiconductor Surface and Related
Processing Equipment

REPLY BRIEF

Commissioner for Patents

Washington, DC 20231

Dear Sir:

In response to the Examiner's Answer mailed January 29, 2002, Appellant respectfully presents his Reply Brief in further support of his appeal in this application.

Appellant maintains the arguments presented in Appellant's Brief filed June 18, 2001. This Reply Brief is directed only to those points of argument that were raised by the Examiner in response to Appellant's Brief.

Appellant urged, in his Brief, that the Nozaki et al. reference fails to disclose the providing of a gas comprised of a mixture of nitrogen and oxygen. Appellant thus argued that the reference necessarily fails to disclose striking a plasma to cause thermal nitridation and thermal oxidation of a portion of a silicon-containing structure (as in claim 1 and its dependent claims), creating a plasma to cause thermal nitridation and thermal oxidation of a bottom structure (as in claim 7 and its dependent claims), and subjecting a substrate to a plasma

wherein the combination of the provided gas, elevated temperature, and plasma result in thermal nitridation and thermal oxidation of a portion of the substrate (as in claim 13).

In response to these arguments, the Examiner urged that the Nozaki et al. reference teaches the use of a quartz tube in combination with its nitrogen-containing gas, and that "[i]nherently, the oxygen from the quartz tube would incorporate with the nitrogen-containing gas resulting in a gas comprising a mixture of nitrogen and oxygen".¹ Based on this interpretation, the Examiner asserted that thermal nitridation and thermal oxidation of the underlying structure results from subsequent heating of the silicon-containing structure in this gas mixture, as taught by the Wolf reference.² The Examiner then concluded that Appellant's arguments were without merit, based on the inherent presence of oxygen gas from the quartz tube.

Appellant respectfully submits that the Examiner's rebuttal of Appellant's arguments is in error, and cannot support the rejection.

The Nozaki et al. reference fails to teach oxidation of the silicon-containing structure

Even accepting, for the sake of argument, the Examiner's premise that the Nozaki et al. method inherently includes oxygen in its gas from the decomposition of the quartz reaction tube, Appellant respectfully submits that the reference falls short of the claims because there is no teaching, express or inherent, of the oxidation of a silicon-containing surface by this oxygen.

Nowhere in the Nozaki et al. reference is there any indication that its oxygen contaminant from the quartz tube oxidizes the silicon that is present, or even that this oxygen results in the formation of a silicon oxide. In contrast, numerous locations of the reference instead refer to oxygen as simply present in the silicon nitride film.³ While the reference repeatedly refers to the compound of silicon nitride, which is produced from the nitridation of

¹ Examiner's Answer, January 29, 2002, page 5.

² Wolf et al., *Silicon Processing for the VLSI Era*, Vol. 1, p. 300.

³ U.S. Patent No. 4,298,629 to Nozaki et al., Abstract, lines 10 and 11; column 2, lines 35 through 38; column 3, lines 3 through 6; column 6, lines 20 through 26; column 6, lines 51 through 58; column 6, lines 59 through 63; column 7, lines 9 through 15; column 7, lines 59 through 62.

silicon by the disclosed nitrogen source gas, the reference only refers to elemental oxygen, and not to any compound of this oxygen with silicon (i.e., silicon oxide). Nowhere does the reference give the reader the impression that oxygen from the quartz tube oxidizes any silicon-containing structure. The Nozaki et al. reference therefore fails to expressly disclose the oxidation of silicon by oxygen from the decomposition of the quartz reaction tube.

Appellant agrees that a prior art reference that does not expressly teach an element of a claim can still anticipate the claim if that element is inherent in the reference. However, the law requires that inherency be established by extrinsic evidence that clearly shows that "the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill."⁴ In the context of examination by the Patent and Trademark Office, an Examiner must "provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art."⁵

First, even accepting that the Wolf et al. reference teaches that oxidation occurs from the heating of a silicon structure to an elevated temperature in the presence of nitrogen and oxygen, there is no basis in fact or technical reasoning provided to support the Examiner's position that the oxygen from the decomposition of the quartz tube in the Nozaki et al. reference necessarily results in such oxidation. There is no teaching from the Nozaki et al. reference or from extrinsic evidence that the oxygen contaminant of the reference is present in sufficient amount, or at the appropriate time in the process, or even in a chemically combinable or active form, to cause oxidation of the underlying silicon surface. For example, referring to the disclosed Auger analysis in the reference,⁶ one can readily surmise that the amount of oxygen released from the quartz tube is insufficient to oxidize the silicon, or that the oxygen released from the quartz tube is produced too late in the process (i.e., after the silicon nitride is already formed) to reach and oxidize the silicon. One can even further surmise from the Auger analysis that the oxygen may

⁴ *In re Robertson*, 169 F.3d 743, 49 USPQ2d 1949 (Fed. Cir. 1999), F.3d at 745, citing *Continental Can Co. v. Monsanto Co.*, 948 F.2d 1264, 1268, 20 USPQ2d 1746, 1749 (Fed. Cir. 1991).

⁵ *In re Levy*, 17 USPQ 2d 1461 (Bd. Pat. App. & Interf. 1990).

⁶ Nozaki et al., *supra*, Figure 5.

be present in the form of quartz particles or molecules released from the reaction tube itself, rather than as oxygen in a form that can oxidize silicon. There is nothing in the reference, and nothing presented by the Examiner in the form of extrinsic evidence, that contradicts any of these alternative explanations. Therefore, one cannot conclude that the decomposition of the quartz tube necessarily produces oxygen gas that necessarily oxidizes the silicon structure. The Nozaki et al. reference therefore cannot be found to inherently disclose the recited oxidation.

Second, Appellant submits that the Nozaki et al. reference itself indicates that oxidation does not necessarily occur. As noted above, the reference discloses that oxygen concentration in its silicon nitride film "includes the oxygen which is adsorbed on the surface of the silicon nitride films as foreign matter."⁷ This passage of the reference teaches the reader that the oxygen contaminant is combined into the silicon nitride by an alternative mechanism to oxidation, namely adsorption on the surface. Especially considering that the reference wholly lacks any teaching regarding oxidation by this oxygen contaminant, the disclosure of this alternative mechanism requires a finding that oxidation of silicon does not necessarily occur in the Nozaki et al. reference from decomposition of its quartz reaction tube.

Appellant therefore submits that, even if oxygen is produced by decomposition of the quartz tube of the disclosed apparatus and process, the Examiner has not provided a sufficient basis from which one can reasonably conclude that this oxygen necessarily oxidizes silicon. The Nozaki et al. reference therefore cannot be found to inherently teach the oxidation required by the claims in this case.

Instead, one can more reasonably conclude that the Nozaki et al. reference in fact teaches that its oxygen contaminant does not oxidize the underlying silicon. This premise is perhaps the more reasonable reading of the Nozaki et al. reference, considering that the oxygen in the resulting film is always referred to in terms of oxygen concentration in silicon nitride, not as a mixture of silicon dioxide and silicon nitride. The teaching of the reference that oxygen is adsorbed on the surface of the silicon nitride film supports the conclusion that this oxygen contaminant in fact did not oxidize the underlying silicon. Appellant therefore submits that the

Nozaki et al. reference gives the reader the impression that oxygen produced by decomposition of the quartz reaction tube does not oxidize the underlying silicon.

For these reasons, Appellant respectfully submits that the teachings of the Nozaki et al. reference, whether expressly stated or properly shown to be inherent, fall short of the requirements of the claims on appeal in this case. Appellant submits that the Examiner's position to the contrary on this point is in error, and cannot support the rejection of the claims.

Providing a quartz tube is not providing a gas

As noted above, the Examiner asserted that the decomposition of the quartz tube in the Nozaki et al. reference inherently results in a gas comprising a mixture of nitrogen and oxygen. Even accepting this premise for the sake of argument, Appellant submits that the reference falls short of what the claims require, namely the providing of a gas comprising a mixture of nitrogen and oxygen.

The Examiner does not dispute that the Nozaki et al. reference fails to disclose the intentional providing of a gas containing oxygen. Instead, the Examiner indicates that oxygen is present in the gas by virtue of decomposition of the quartz tube, albeit unintentionally.⁸

The claims on appeal each require the step of providing a gas comprising, or comprised of, a mixture of nitrogen and oxygen. The Nozaki et al. reference teaches the providing of a gas that does not contain oxygen and, according to the Examiner, the providing of a quartz tube. However, the act of providing a quartz tube is simply not the act of providing oxygen gas. These two acts are entirely different from one another. Indeed, the skilled reader is encouraged by the teachings of the Nozaki et al. reference to eliminate oxygen from a nitridation reaction, and is discouraged from intentionally adding oxygen into the gas provided to the reaction, considering that the reference is concerned with reducing the effects of oxygen contamination that is present in the reaction chamber in the absence of oxygen gas.⁹

⁷ Nozaki et al., *supra*, column 6, lines 20 through 22.

⁸ Examiner's Answer, page 6.

⁹ See, e.g., Nozaki et al., *supra*, column 6, lines 22 through 28; column 8, lines 33 through 41.

Appellant therefore respectfully submits that the Nozaki et al. reference fails to teach the step of providing a gas comprised of a mixture of nitrogen and oxygen, as required by all of the claims on appeal in this case. To the extent that the final rejection is based on the premise that the Nozaki et al. reference meets this providing step of the claims, Appellant respectfully submits that the rejection is in error and should be reversed.

Conclusion

For these reasons, and for the reasons stated in Appellant's Brief, Appellant respectfully submits the teachings of the applied prior art, properly interpreted, fall short of the requirements of each of the claims on appeal.

Appellant further maintains, as stated in his Appellant's Brief, that there is also no suggestion from the prior art to modify the teachings of the applied references in such a manner as to reach the claims on appeal in this case. In summary, the Nozaki et al. reference is specifically directed to the reduction of oxygen, as a contaminant or "foreign matter", in its formation of a nitride film, negating any suggestion to modify its teachings to include oxygen in its reacting gases. Appellant therefore submits that the claims on appeal are therefore not only novel, but patentably distinct over the applied prior art.

Appellant therefore maintains that the final rejection of claims 1 through 5, 7 through 10, and 13 under §103, is in error. Reversal of the final rejection is therefore respectfully requested.

Respectfully submitted,



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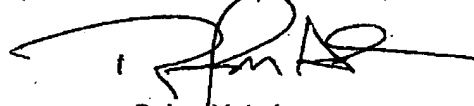
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